AN INTRODUCTION TO THE CLEAN WATER ACT AND TMDLs

SESSION INFORMATION:

Moderator:

Don Elder, River Network

Presenters:

Sharon Clifford, Missouri Department of Natural Resources
What's New on TMDLs?

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(no paper submitted)

AN INTRODUCTION TO THE CLEAN WATER ACT AND TMDLs

What's New on TMDLs?

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The TMDL issue is in a constant state of flux. As the regulation of water quality moves from "technology-based" controls to "water-quality based" controls, many precedents need to be set. It has been stated that agencies are in the same place they were in the early days of the National Pollutant Discharge Elimination System (NPDES) permit program. How are they going to implement the changes needed to improve water quality? In the beginning, the NPDES Program was contentious and in a state of flux. Currently the TMDL program is contentious and in a state of flux. The two primary factors influencing change in TMDLs are litigation with the subsequent court decisions, and EPA rule changes.

Lawsuits
The 303d listing of impaired waters and production of load capacities, TMDLs, for impaired waters has been part of the Clean Water Act (CWA) from the beginning. These facets of the CWA were largely ignored as government focused its efforts on point sources of pollution. As the balance tipped from impairments due to point sources to impairments due to nonpoint sources, environmental groups like the National Resource Defense Fund, Sierra Club, American Canoe Association, and others began suing EPA over their failure to enforce this part of the CWA.

At this time, EPA TMDL web site shows 34 states being involved in lawsuits regarding TMDLs. There are more than 40 lawsuits in total. Some states, like California, are involved in multiple lawsuits. Officially, the lawsuits are filed against EPA to force them to force states to develop TMDLs. If a state fails to do so according to the terms set forth by the court, EPA must be a "back stop" and develop the TMDLs for the state. Some lawsuits over TMDLs involve individuals instead of agencies. This is one of the most litigious environmental issues ever.

Lawsuit Issues
- Ensure TMDLs are completed by state agencies or EPA
- Nonpoint source (NPS) TMDLs
- Time frame for completion
- Watersheds crossing state boundaries
- Scientific basis for listing and TMDLs

The major point of the lawsuits is the requirement to identify impaired waters (regardless of the source of impairment) and ensure efforts to remediate water quality problems. The most controversial issue is whether agencies have the legal authority to develop and implement TMDLs in watersheds where nonpoint sources are the major contributor. Will agencies regulate/permit nonpoint sources, particularly agriculture and forestry? Many lawsuits take issue with the timelines set forth for the completion of TMDLs. Watersheds crossing political jurisdictions are particularly difficult as states often have different Water Quality Standards and listing criteria. This difficulty can result in the same water body being listed for different impairments. Opponents to TMDLs are concerned that states do not have adequate data to determine water body impairments, that modeling will not accurately predict load capacities, and that implementation plans may or may not succeed.

Lawsuit Related to NPS TMDLs
- Pronsolino V. Marcus– California District Court decision stating that agencies have the authority to develop NPS TMDLs
- Hawes V. State of Oregon– Case filed in County Circuit Court claiming that Oregon has "Wrongfully Acceded" to EPA in agreeing to develop TMDLs on NPS impairments

Originally Missouri was sued by three organizations, the American Canoe Association, the Sierra Club and the Soybean Association. Because all three suits addressed TMDLs, the court has rolled them into one suit. This complicates the issue as often the opinions of the environmental groups are diametrically opposed to the opinions of the agriculture group. For example, Sierra Club wants more waters listed and Soybean Assn. wants fewer listed. The same is true for the use of volunteer data. Environmental groups want it used more extensively and agricultural groups do not believe it should be used in any way due to quality assurance issues. Does the Clean Water Act give regulatory authority to EPA for nonpoint sources of pollution? This issue is being decided in the courts. The ruling in the California case was seen as a major victory, but does not set a national precedent that requires an Appellate Court decision. EPA and states are proceeding with the understanding that the Clean Water Act applies to all water resources, including those impaired primarily by NPS.

EPA Rule Changes
Because we are at the beginning of a change in how water pollution is being addressed, changes in the program are expected and may occur for several years to come. Agencies are working together and looking to each other for successes to establish the best procedures for water quality based regulation.

Just prior to April 1, 2000, EPA changed the submission date for the biennial 303d list. In Missouri, a 2000 list had been drafted, gone through public notice, been addressed in a hearing and had gone through a second public notice before it was tabled due to pending changes in the EPA requirements. The revised 303d list will not be required to be submitted until April 1, 2002. At this point, it is not clear whether revising the 303d list every four years instead of every two years is a permanent change.

Changes to Proposed TMDL Rule Changes

- Drop identification of Threatened Waters
- Drop public petition process
- Drop rigid approach to prioritizing impaired waters
- Drop requirements for 1.5:1.0 offset for new discharges
- Eliminate possibility of permits for runoff from diffuse sources

Non-Changes to Proposed TMDL Rule Changes

- 15 year schedule
- Comprehensive listing of impaired waters
- Identify ALL sources of impairment
- Identify pollution reduction needed
- Require reasonable assurance
- Push implementation

EPA proposed new rules to expand the TMDL requirements. A letter was issued April 5, 2000, by Chuck Fox, Assistant Administrator for water, clarifying the direction EPA is going with these rules. The communiqué from Mr. Fox also clarified which elements are likely to remain in the proposed TMDL rule. The existing rules have 5 required elements for a TMDL:

- Name & Location of water body
- Margin of Safety
- Seasonal Variation
- Wasteload Allocation
- Load Allocation

5 more required elements were to be added by the proposed rules:

- Pollutant Load
- Load Reduction to meet WQ Standards
- Sources
- Allowance for Future Growth
- Implementation Plan

Voluntary Programs and Local Involvement for Nonpoint Source Impairments

The major goal of all agencies, state and federal, is to improve water quality through NPDES permits, voluntary programs, and Best Management Practices (BMPs). This will require local input onto feasible solutions and funding to make solutions cost effective. Budgets for 319 grants and USDA/NRCS are increasing and more money is being requested. EPA's TMDL web site is very informative and up-to-date. Missouri's web site is included as an example of a state TMDL web page. Many other states have similar pages on their web sites.

Role of Volunteer Monitoring in TMDLs

States should look at all available data, when developing their 303d list, including volunteer data. Many, but not all, states do not have an adequate ambient data set to evaluate every water body. Missouri is one of those states. Agency monitoring efforts have traditionally been targeted to permitted, point source facilities. Some waters, therefore, have little or no data generated for them or only have data for a limited area of the watershed. Agencies in general need more data.

Web Sites

- EPA website for TMDL information: http://www.epa.gov/owow/tmdl
- Missouri DNR website for TMDL information: http://www.dnr.state.mo.us/deq/wpep/wpe-tmdl.htm

Because of cost issues, most volunteer monitors are not able to use the best available technology for monitoring. Many times their equipment does not exactly follow Standard Methods. This does not, however, make their data useless. Volunteer data can help agencies screen for unknown problem areas and identify emerging trends. Volunteers are out in the watershed much more frequently than agency personnel. Their information can supplement existing agency data to verify and defend identified impairment. In Missouri, volunteer data has consistently been in close agreement with agency data. Volunteers can serve a similar role in monitoring implementation efforts to ensure they are effective.

The bottom line is that the more information decision makers have, the better decisions they will make. If volunteer data is of a known quality and meta data is available to fully describe and document it for decision makers, it can be a valuable addition to the body of knowledge on water resources.

Participating in water quality monitoring gives interested individuals a true understanding of the resource. Monitoring changes ethics and behaviors. It can provide citizens with the knowledge base and confidence to speak out on issues. If volunteer monitors are willing to get involved in the political process and influence decision makers at all levels, they can make a huge difference in the resources committed to water quality.

One of the more important roles volunteers can play is to work on impaired waters in their local community. Since the solution to nonpoint source impairments is locally driven watershed projects, it is important that volunteers be willing to serve on decision making committees. Many watershed organizations are formed with the intent of including all stakeholders. But often, only those with an economic interest in the issue actually participate. Concerned local citizens with an understanding of the complexity of the resource can be invaluable in restoration efforts.

Missouri uses volunteer monitoring data when revising the 303d list. Chemistry values exceeding WQ standards are pulled from the database. In the case of parameters that do not have standards, such as nitrates, a value deemed above the normal background (in MO, 6.0 mg/L) is queried for. Parameters that are variable, such as ammonia, are looked at if they are above 3.0 mg/L. This may or may not indicate a problem, but that determination can be made by looking at temperature and pH data. Low invertebrate ratings are used to support biological impairment. It can also be helpful to pull volunteer data in waters designated as impaired to get a more accurate feel for seasonal variation, low flow levels, etc.

Missouri Stream Teams have organized into Associations according to major watersheds. Recently, several Stream Team associations met to form the Missouri Watershed Coalition. If funded, the coalition will help local Stream Teams obtain grants, represent Stream Teams in the State Legislature, and serve as a resource for new teams and watershed associations. Stream Teams are very active and effective in their advocacy efforts at all levels of decision making. Last year, the Missouri Department of Natural Resources was allocated 45 additional full time employees to work on data collection and TMDL issues (funded by state general revenue and EPA grants). Many believe the increased participation by Stream Teams and other concerned citizens is in part responsible for the success of the agency in getting support for water quality issues.

MONITORING IN THE URBAN ENVIRONMENT

SESSION INFORMATION:

Moderator:

Michele Witten, Green Mountain Institute for Environmental Democracy

Presenters:

Jim Harrison, USEPA Region 5
Lullwater Fork Improvement Project (Atlanta, GA USA): Integrating Innovative Urban Watershed, Hydrology, and Planning Approaches with "the Usual" Monitoring

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Urban Watch: Bringing Citizens, Scientists, & Cities Together
(abstract only)

MONITORING IN THE URBAN ENVIRONMENT

Lullwater Fork Improvement Project (Atlanta, GA USA): Integrating Innovative Urban Watershed, Hydrology and Planning Approaches with "the Usual" Monitoring

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Metro Atlanta Context

Water crises around metro Atlanta and North Georgia are extensive and include water supply and waste water infrastructure needs, multi-state water supply allocation (AL, FL, GA "water wars" negotiations), combined sewer overflows, sanitary sewer leaks and capacity problems, and storm water (AJC 2000). Monitoring of Atlanta's urban streams through the Metro Atlanta Urban Watershed Initiative (MAUWI 1998) revealed that most area streams are moderately to severely degraded biologically. Stresses causing impairment are many, including combined sewer overflows (CSO's), sanitary sewer overflows (SSO's), leaking sewer systems and faulty septic systems, riparian degradation, hydrologic alteration mainly due to impervious surfaces, polluted runoff from streets/parking lots/homes, sedimentation from construction and stream bank erosion, and point sources and illicit discharges. The primary problem preventing recovery of area streams is storm water runoff from impervious surfaces, mainly roads, parking lots and buildings. The vast majority of metro Atlanta streams are now listed on the State of Georgia's Section 303(d) impaired waters list, and are subject to Total Maximum Daily Load (TMDL) development and implementation.

A wide array of interests are now engaged in debate and action concerning the future of Atlanta's streams. Governor Barnes has convened a study group of business leaders (Pruitt 2000) to make water quality and supply recommendations including how to address storm water runoff. Citizen's groups are active at many levels. These groups include Georgia Legal Watch's Community Watershed Project, the Upper Chattahoochee Riverkeeper, the Peachtree/Nancy Creek Technical Advisory Committee, the Peavine Watershed Alliance, and many others.

Lullwater Fork is a small urban stream (1.61 square miles watershed area) in Metro Atlanta, (Southern Piedmont ecological region (Omernik 1995)). Watersheds and ecological regions are both essential spatial frameworks for understanding aquatic resource potentials and stresses (Omernik and Bailey 1997). Lullwater Fork flows to Peavine Creek (a tributary of the South Fork of Peachtree Creek) and then to the Chattahoochee River. The Chattahoochee is Metro Atlanta's primary source of drinking water and, with the Chattahoochee River National Recreation Area, a prominent recreational destination. The location of the Lullwater Fork Project is shown in Figure 1. Key stresses and impacts on the Lullwater Fork of Peavine Creek include: diminished biological integrity, fecal contamination (likely from sewer leaks, overflows and storm water), stream bank erosion due to riparian and storm water pressures, downstream flooding and wholesale stream habitat destruction due to channelization (concrete lining and culverting) of about 1/3 of stream length in the watershed (see Walker 1996). Such stresses are typical of Atlanta urban streams. An independent panel of scientific and technical experts convened by the International Life Sciences Institute (ILSI) Risk Science Institute selected the Lullwater Fork as a proposed site for demonstrating stream restoration in Metro Atlanta. It was recommended as a demonstration site because it is a highly degraded headwater stream that can be rehabilitated to a healthier condition for the least cost (ILSI 1998).

Collaborative Partnership

The Lullwater Fork Improvement Project is a collaborative effort targeting restoration and protection of a small urban Atlanta watershed. The project is led by the Paideia School with numerous partners including: Candler Park Neighborhood Organization, Lake Claire Neighbors, Freedom Park Conservancy, Peavine Watershed Alliance, Southeast Waters - Americorps, Southface Energy Institute, HDL/W.L. Jorden Engineers, Center for Watershed Protection, the Nature Conservancy, Walker Foundation, DeKalb County, local and other governments. Generous funding has been provided by the National Environmental Education and Training Foundation, DeKalb County, the

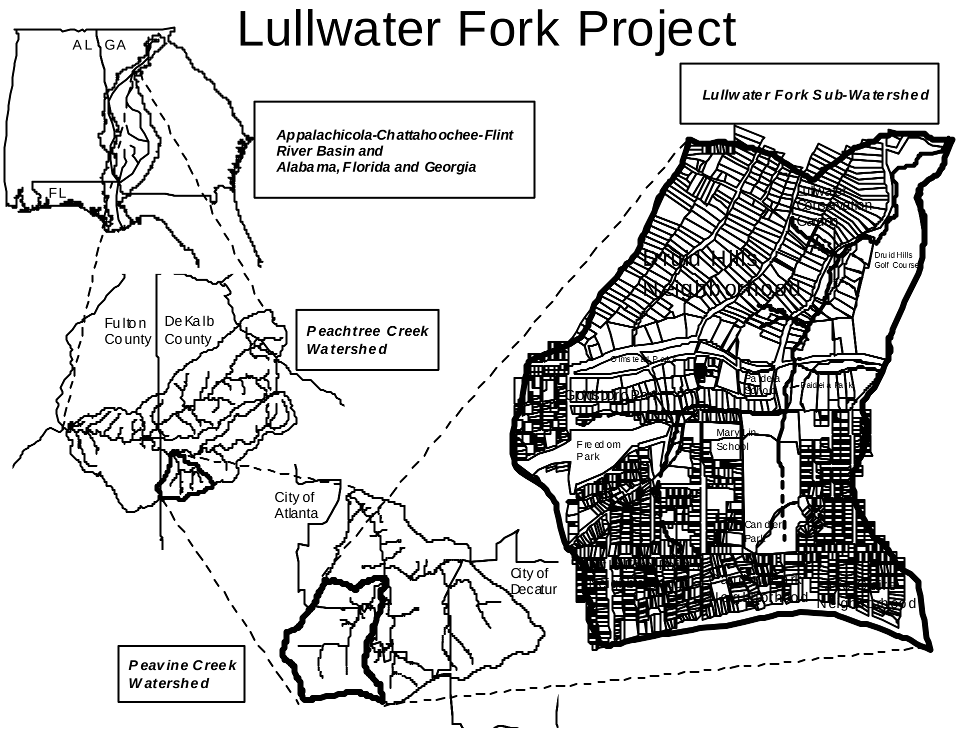

Figure 1

Alex C. Walker Educational & Charitable Foundation, Southface Energy Institute, and Paideia School. Paideia School is a private non profit school located four miles from the center of downtown Atlanta. The school received a donation of 4.2 acres of undeveloped land which is traversed by the Lullwater Fork of Peavine Creek. In studying how to use its land, Paideia learned about the importance of watershed management and its effect on the school's ownership of the property. Since the stream bank erosion and pollution problems originate up-stream, Paideia has worked to build partnerships with property owners in the headwaters. From this study and partnership building, a plan has developed to use the Lullwater Fork as a demonstration project for innovative community based watershed planning and restoration. Paideia wishes to use its property as an outdoor classroom to provide environmental education opportunities for students at Paideia and other local schools. More importantly, the concepts developed by Paideia and its partners will be transferable to other property owners and communities as they address their own watershed management issues.

The Lullwater Project holds regular monthly steering committee meetings to plan and carry out project actions, coordinates with watershed interests at all scales (such as the Peavine Watershed Alliance, the Peachtree/Nancy Creek Technical Advisory Committee, and the Upper Chattahoochee Riverkeeper), and has convened a watershed wide meeting (October 1999) to introduce potential storm water restoration options. Current project emphases involve continued monitoring of stream and watershed indicators, development of education and outreach products, and gaining consensus among neighborhood interests on viable restoration options and funding.

Resource Monitoring

Innovative stream and watershed monitoring are underway to ensure adequate data to design and implement restoration options, facilitate interaction among all interests, and allow evaluation of project success. Adopt-a-Stream monitoring activities include adoption of the Lullwater Fork by the Paideia School and Mary Lin Elementary School, regular monitoring of chemistry, habitat and biology (benthic macroinvertebrates) using the State of Georgia's "Adopt-a-Stream" protocols, regular hosting of Adopt-a-Stream training workshops within the Peavine Creek watershed, annual stream cleanup days, and sharing of data through the Upper Chattahoochee Riverkeeper's web site.

Volunteer monitoring efforts have been supplemented by benthic and fish sampling done by Chris Crow of CCR Environmental Inc. using the Georgia Environmental Protection Divisions's biological and habitat assessment protocols (Crow 2000). Benthic results have been compared to the Adopt-a-Stream protocol results to provide a sound basis to begin relating the volunteer and professional results. Results are also compared to relatively unimpacted reference site samples for two sites: Fernbank Creek in Fernbank Forest (thanks to the Fernbank Science Center), and Snake Creek, a rural watershed also used by the USGS as a reference site for the Upper Chattahoochee.

The high proportion of impervious surfaces (roads, parking lots, buildings, etc.) in the Lullwater watershed (~34%) have resulted in significant hydrologic changes in the drainage much higher and more frequent peak flows due to urban runoff, and likely diminished base flows due to quick runoff from hard surfaces directly connected to the stream drainage network. These changes in stream flow patterns (coupled with riparian vegetation removal over significant stream reaches) greatly increased pressure on stream banks, accelerated stream bank erosion, caused extreme widening and deepening of the stream channel, and severely diminished aquatic habitat quality (see Schueler 1994, May and others 1997, Hammer 1972, and Booth 1994). The importance of hydrologic alterations in the watershed (and likely in most urban watersheds) necessitates measurement of hydrologic factors to guide refinement of storm water restoration potentials and options.

Precipitation data is gathered continuously using a "tipping bucket" rain gage coupled with a battery powered data logger. Rainfall is recorded in 1/100 inch increments and the data is regularly downloaded to a personal computer by a volunteer Paideia School parent. Standard Operating Procedures (SOP) have been documented so that quality data can be collected by other trained users, and to encourage use of comparable systems by other urban watershed groups. The total cost of this system, which uses readily available commercial components, was less than $200. Maintenance and data management for the system takes an average 15 minutes per month.

Stream stage (water height) data is being gathered for the Candler Park Branch of Lullwater Fork by Southeast Waters - AmeriCorps volunteers using an innovative, continuous recording stage logger called the Aquarod, developed for the Forest Service in the Pacific Northwest. This technique also allows regular download of data to a laptop PC in the field. Stage recorder installation is also planned for additional watershed sites, plus potential restoration areas in the neighboring Fernbank Fork watershed. Storm flow velocity measurements are being done by project volunteers (Barrett Walker, a co-author.) Combining the stage and velocity measurements will yield storm water flow volumes which will then be correlated with (and potentially modeled with) rainfall measurements for a range of storms. Long term hydrologic data will allow quantitative evaluation of improvements in hydrologic integrity (Richter and others 1996). AmeriCorps is also documenting stream walk information for Lullwater Fork.

The most significant unmet "on-the-ground" monitoring need of the Lullwater Project is for detailed stream channel geomorphology measurements of both impacted and reference stream channels (Rosgen 1994). Some of these measurements, such as pebble counts to document stream substrate particle size distributions (an important measure of sedimentation stress on aquatic habitat), and bank pin measurements of stream bank erosion can potentially be done by volunteers. Others, including permanent surveyed cross sections, longitudinal profiles (see USEPA 1999) and regional curves for representative Piedmont streams will require more attention from and resources for state, federal and academic researchers and monitoring programs. This work will be essential for targeted channel restoration designs for Lullwater Fork and for many other urban streams (Federal Interagency Stream Restoration Working Group 1998). Other needs include measuring the toxicity of urban runoff "first flush" for further evaluation of the success of future storm water controls.

Watershed GIS Data

One of the key recommendations of the MAUWI technical committee was to make extensive watershed data available to citizen groups to aid planning and action to address storm water impacts to metro Atlanta streams. The Lullwater Project has built on a pilot MAUWI effort to use Geographic Information Systems (GIS) capabilities to make watershed information readily available. Full utilization of remotely sensed (satellite and air photo) watershed information is needed to understand social patterns and decisions that impact urban stream integrity (Cowen and Jensen 1998).

HDR/W. L. Jorden Engineers has compiled a wide array of GIS data for the Lullwater Fork, Fernbank Fork and Peavine Creek watersheds to facilitate planning and discussion of restoration options. Some of the many GIS coverages now available to share via CD-ROM (using ArcView or ArcExplorer ("freeware") software) include: watershed boundaries, land use/land cover, air photos, parcel ownership boundaries, streams, roads, infrastructure (such as water/sewer lines), impervious cover estimates, elevation contours and others. A significant part of this project was the digital entry of property parcels from paper county tax maps. This information is crucial for individuals' understanding of their roles in the Lullwater watershed, and to insure sensitivity to and protection of private property rights. Data was obtained through the Georgia GIS clearinghouse at Georgia Tech, and through a data sharing agreement being negotiated between the Lullwater Project and DeKalb County. All of these data layers were used to develop preliminary restoration options, and are available (currently housed at Paideia School) to all project participants as dialogue proceeds on potential restoration projects. GIS based watershed information provides many benefits: ready visualization of the relationships between watershed components and entities; education of watershed "owners" about their role in the health of the watershed and its streams; common base information that all interests can agree on, can correct if needed, and can be easily updated as watershed conditions change over time; and appropriate emphasis on protection of private property rights.

Rapid Watershed Planning

To begin dialogue about stream restoration possibilities among all watershed interests, the Lullwater Project contracted with the Center for Watershed Protection to produce preliminary concepts for storm water restoration retrofit projects (Brown 1999). Rather than designing a single large regional detention facility that would have been intrusive and opposed by neighbors, a systems approach was taken to integrate eight restoration sites as neighborhood amenities for the Lullwater watershed (and other sites for Fernbank Fork as part of a companion project). Figure 2 shows the approximate locations of the preliminary storm water options; all are subject to revision and final designs may be quite different. Three of these envision micropool extended detention approaches integrated with Candler Park and the Candler Park golf course. Two would rely on stream channel restoration within and adjacent to Candler Park golf course. One involves micropool extended detention at Goldsboro Park, leaving in place the tennis and basketball courts as part of the flood pool. Another would use a small constructed wetland integral to Freedom Park. Design parameters of these initial options incorporate storm water storage volumes sufficient to gain significant water quality benefits, and a significant fraction of the storage volume required for stream channel protection (bank full flows) (see Center for Watershed Protection 1998a &b).

Challenges for implementation of these ideas include ensuring that the concepts and final designs meet the neighborhoods' and property owners' needs and preferences, choosing an array of options that will get the most water quality and channel protection benefits, making the installations truly beneficial amenities to the parks and golf course, funding for detailed design and construction, and ensuring long term regular maintenance of all the facilities.

Watershed Education and Action

Lullwater Project outreach products include GIS maps and outdoor educational displays. Data and restoration alternatives are now being assembled by the Southface Energy Institute to produce educational signs, presentations and other materials. Both permanent and temporary public signs are planned for prominent locations including parks, paths, schools and museums. Restoration options have been presented to the Candler Park Neighborhood Organization and Freedom Park Conservancy. Several options have been approved to seek implementation funding. Broader watershed-wide education will likely involve cooperative efforts with the Peavine Watershed Alliance, and with others who are collaborating on a "watershed owner's manual" tailored to individual homeowners and businesses. The Lullwater Project will promote both individual action, such as infiltration of house top runoff vs. direct piping to streets and streams, and community based approaches such as extended detention and stream channel restoration opportunities.

Stormwater Retrofit Options for Lullwater Fork

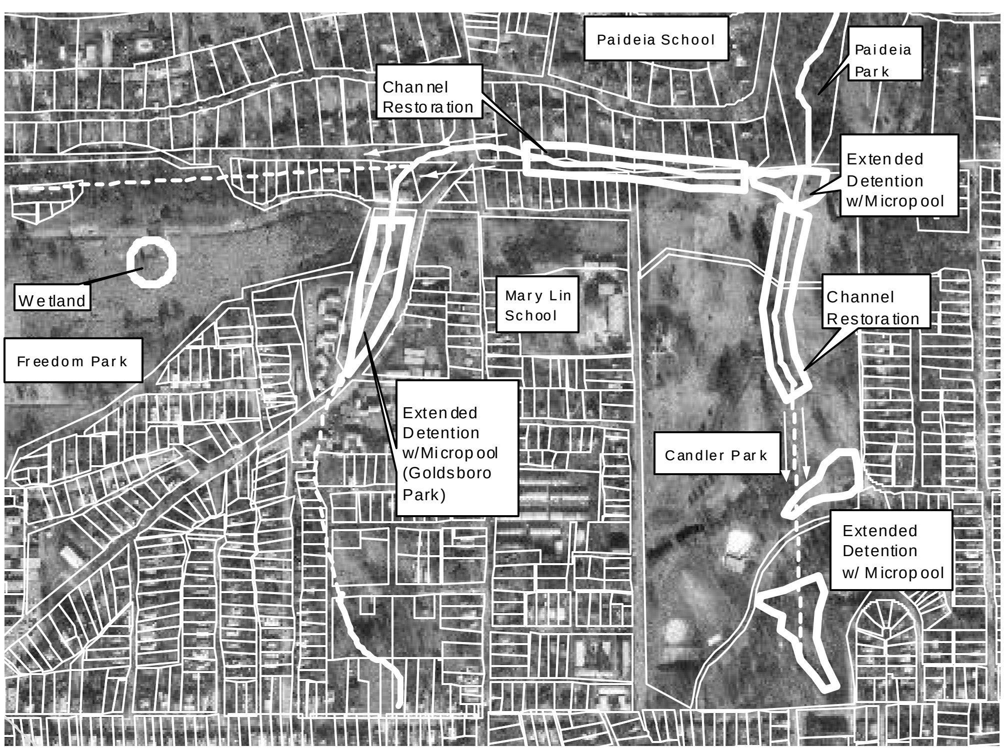

Figure 2

Recommendations

Urban streams have significant stresses that differ from their rural counterparts. Biological, habitat, hydrologic and stream channel changes, in addition to chemical stresses (Karr 1993), must be measured and addressed to maximize the likelihood of success of restoration actions. Biological integrity, as the bottom line measure of stream system health, must be documented, both for a current picture of stream condition, and for evaluation of restoration project success. Urban watersheds were not "built out" in a day, and achieving maximum restoration potential will likely require sustained effort over a long time. Iterative, adaptive, continuous learning approaches (Johnson 1999) will be important since resource, knowledge, and volunteer energy constraints must be recognized. Effective development practices that protect water resources should be swiftly adopted by all local jurisdictions (Nichols and others 1997 and 1999) to prevent future storm water problems that we know how to avoid, and to promote innovative restoration.

Funding of storm water restoration action needs local, regional, state and national attention. Viable options that deserve sincere discourse include: watershed-wide, cost based, storm water utilities with service fees tied to parcel specific effective impervious areas [Note: In January, 2000 the City of Decatur, which covers a portion of the Peavine Creek watershed, passed an ordinance initiating a user-fee funded storm water utility], supplemental gas taxes for watersheds with significant impervious area (since roads comprise roughly 2/3 of the impervious area in many urban watersheds), and additional private and government support for pilot efforts while long term effective planning, funding and maintenance is structured.

Finally, development of storm water solutions that will work and be accepted must incorporate full citizen involvement and true partnerships between citizens and governments at all watershed scales: small (1-5mi^2), medium (5-100mi^2), and large (>100mi^2). To date, the most compelling outcome of the Lullwater Project continues to be that diverse organizations and strongly committed individuals are working together toward the common goal of clean, healthy streams that everyone can enjoy.

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MONITORING IN THE URBAN ENVIRONMENT

UrbanWatch: Bringing Citizens, Scientists and Cities Together

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Nature in cities is the focus of UrbanWatch, a volunteer environmental monitoring program designed to characterize native biodiversity in urban ecosystems. Our cities are interspersed with environments in which nature persists, even thrives -- cemeteries and golf courses, backyards and empty lots, parks and corporate campuses, tree-lined residential streets and railroad rights-of-way. Hardly the rain forest or the African plains, perhaps, but the adaptable plants and animals that inhabit cities can be just as interesting as those in more exotic places.

While the ecological principles at work in cities may be well understood, the details of urban ecosystems themselves remain largely a mystery. Most ongoing field surveys and environmental data-gathering are done for purposes other than ecological understanding. This presentation will detail the rationale behind this innovative addition to Illinois* volunteer environmental monitoring network. Highlights of field testing and pilot workshops will demonstrate the challenges of developing a monitoring program for urban ecosystems as well as the potential for increased environmental awareness and new information about the biodiversity of urban ecosystems.

EcoWatch is the volunteer monitoring component of the Critical Trends Assessment Program, an on-going program at the Illinois Department of Natural Resources to track long-term trends in ecosystem health. Since 1994, over 2,000 trained volunteers have monitored more than 600 different monitoring sites. Data collected by Citizen Scientists supplements professional scientific databases used to assess the condition and extent of ecosystems statewide.

PROGRAM ROUNDTABLE A

SESSION INFORMATION:

Moderator:

Mandy Richardson, Environmental Scientist, Tetra Tech, Inc.

Presenters:

Josh Clemons, GLOBE
A Comparative Study of GLOBE and USGS Water Quality Monitoring Data

Yvette de Boer, SUNY College of Environmental Science and Forestry
Citizen Volunteer Monitoring of Forest Resources in the New York City Watershed

Nancy Mesner, Utah State University, Department of Geography
Bear River Watershed Education Project
(abstract only)

PROGRAM ROUNDTABLE A

A Comparative Study of GLOBE and USGS Water Quality Monitoring Data

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Introduction

Global Learning and Observations to Benefit the Environment (GLOBE) is a K-12 international science and education program. Over 100 schools in the U.S. measure some aspect of water quality, including water temperature, pH, dissolved oxygen, alkalinity, electrical conductivity, nitrate-nitrogen, salinity, and water transparency. The schools choose the water bodies to be sampled, which are primarily small tributary streams or lakes. As a consequence, GLOBE schools in the U.S. sample a different population of water bodies from that of professional monitoring programs–such as those run by the U.S. Geological Survey (USGS). Data from GLOBE and from the USGS National Stream Quality Accounting Network (NASQAN) program can be analyzed to address the question *how different are the water quality attributes of small versus large water bodies in the U.S.* Specifically, we compare two data records for sites that are in close proximity to each other, Mill Creek and Colorado River in Utah, and then we examine distribution of parameters for a subset of GLOBE sites that have greater than 500 hydrology measurements versus NASQAN sites. Data for one water quality parameter, alkalinity, are also examined to illustrate the comparative variability of GLOBE and USGS data.

Water quality assessments aim to establish the attributes of one or more water bodies, establish differences between the water bodies' samples, and detect changes in those water bodies over time. An important issue in evaluating data used to detect differences or change is how natural variability in water quality associated with temperature changes and seasonal cycles can be separated from climate or land use changes. Professional monitoring programs, such as those of the USGS and other public agencies, have established quality assurance and quality control programs that result in a known accuracy and precision for their results. These programs are generally more rigorous than those of GLOBE and other volunteer organizations. The result is that GLOBE and other volunteer data are assigned a lower level of precision than data from professional monitoring programs. However, volunteer data can still make valuable contributions to environmental assessments, as they cover a different population of water bodies from that covered by the professional programs. By comparing the means and seasonal patterns of GLOBE data with those from professional programs we can establish that over periods of months to years, most GLOBE data are sufficiently accurate to be useful for water quality assessments.

In the U.S., GLOBE samples a different population of water bodies than do professional monitoring programs such as those run by the USGS, which tend to focus on larger rivers and lakes. In the current analysis we use data from GLOBE and NASQAN to assess the differences in water quality attributes of small versus large water bodies in the U.S. Specifically, we compare two data records for sites that are in close proximity to each other, Mill Creek and Colorado River in Utah, and then we examine distribution of parameters for a subset of GLOBE sites that have greater than 500 hydrology measurements versus NASQAN sites. To effectively assess water quality changes over time, the frequency, accuracy and precision of the water quality measurements must be known. To assess GLOBE accuracy and precision we take one parameter, alkalinity, and compare the data variability of GLOBE and USGS data. We also examine GLOBE sampling frequency.

Study Area

Mill Creek is a small stream draining a 15 km^2 watershed in eastern Utah (Figure 1). It is a GLOBE site, sampled by the Grand County High School in Moab, and is a tributary to the Colorado River. The GLOBE site is located at 38°34'19" N latitude, 109°32'43" W longitude, elevation 1234 m. The NASQAN sampling point is at Cisco, Utah (Figure 1), where the river drains a 62,413 km^2 upstream area. The NASQAN site is located at 38°48'38" N latitude, 109°17'34" W longitude, elevation 1247 m. The Colorado River drains a large portion of seven states, and over 85% of the runoff in the river derives from snowmelt.

Data

GLOBE data were obtained from the GLOBE student data archive in June 1999, and consisted of water temperature, dissolved oxygen, pH, and alkalinity for the period from March 8, 1996 through September 23, 1998 (Figure 2). NASQAN data for the same time period were downloaded from the NASQAN Public Homepage (Figure 3). For the comparison of variability of alkalinity data, GLOBE and NASQAN alkalinity data for the period from July 1, 1996 through June 30, 1999, were used.

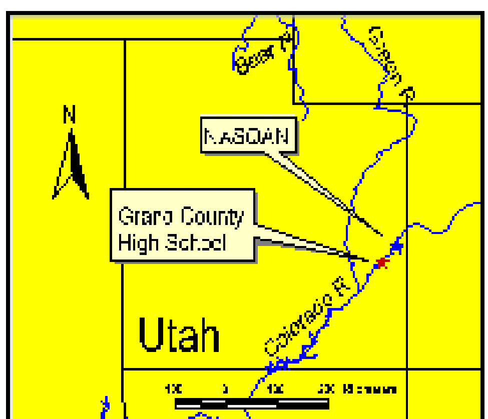


Figure 1: Utah site locations.

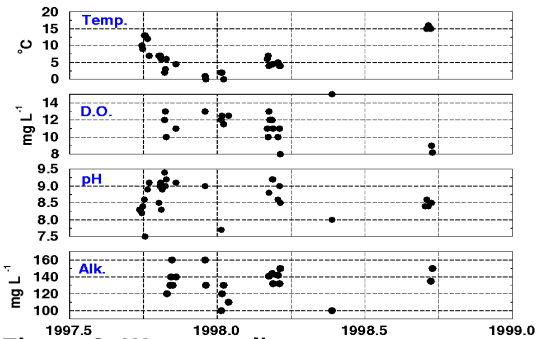


Figure 2: Water quality measurements made on Mill Creek, Moab, Utah by Grand County High School, a GLOBE school.

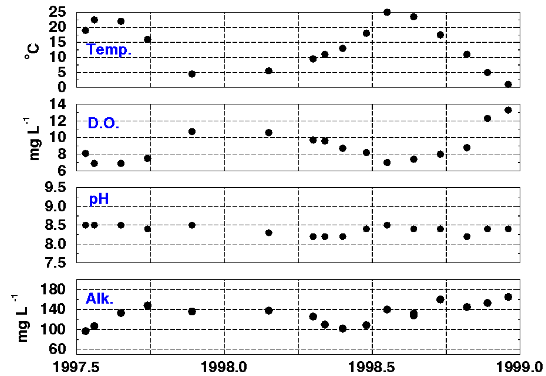


Figure 3: Water quality measurements made on the Colorado River at Cisco, Utah by USGS under the NASQUAN program.

Results

Mill Creek GLOBE data cover mainly the period of winter 1997-98, with intermittent sampling before and after. Sampling during this period was sufficiently frequent to permit establishing trends using a running mean. Applying a 1:2:1 triangular filter to the GLOBE and NASQAN data results in distinct trends: i) temperature shows a minimum around the time of the solstice, ii) dissolved oxygen (D.O.) has a corresponding maximum at the same time, and iii) pH and alkalinity exhibit minima in winter, as compared to late fall and early spring (Figure 4). Similar trends in temperature and D.O. are apparent in the Colorado River data (Figure 5). We also calculated saturated D.O., based on temperature and elevation. Mill Creek is near saturation for the entire period (Figure 6), and the Colorado River is slightly under saturated. Comparing the two sites shows the following differences: i) Mill Creek is about 0.5-1.0° C cooler than the Colorado River, and the dissolved oxygen level is about 1-2 mg L^{-1} higher in Mill Creek than in the Colorado River; ii) pH in Mill Creek is lower than that of the Colorado River by about 0.3 standard pH units; and iii) Mill Creek has about 6.5 mg L^{-1} higher (~5% higher) alkalinity than the Colorado River.

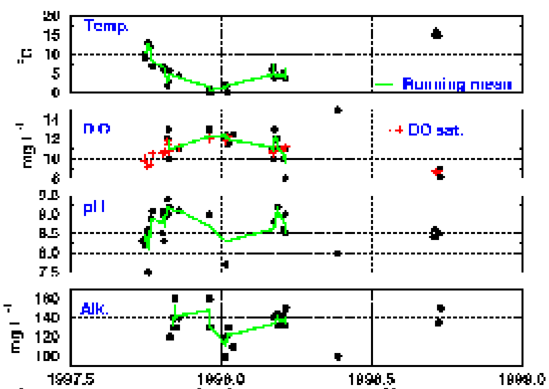


Figure 4. Trends in water quality measurements on Mill Creek near Moab, Utah (GLOBE).

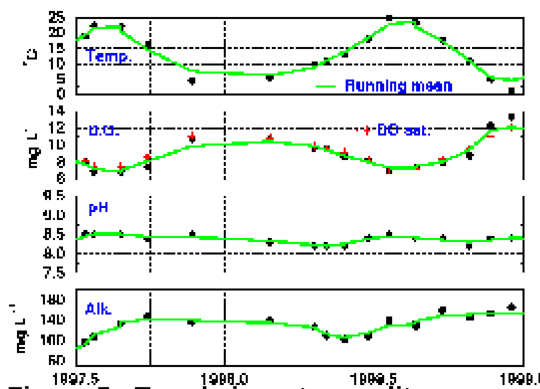


Figure 5. Trends in water quality measurements on Colorado River at Cisco, Utah (NASQAN).

To extend the comparison nationwide we compared data from all 38 NASQAN sites with those for all GLOBE sites having more than 500 hydrology measurements (Figure 7). That resulted in a variable number of GLOBE sites for each measurement, but distinct differences in mean values for each parameter. Alkalinity results for 27 GLOBE sites showed a mean lower than that for NASQAN sites (by about 50 mg L^{-1} as $CaCO_3$), but a similar standard deviation (Figure 8). The result is a coefficient of variation (standard deviation divided by mean) of 15% for NASQAN, versus 30% for GLOBE. Variability of GLOBE data for other parameters has been found to be somewhat higher than that of USGS data, although less so than for the alkalinity data. Water temperature was about 2.4° C cooler at GLOBE versus NASQAN sites (Figure 9). Dissolved oxygen was similar for both populations of sites (Figure 10). Electrical conductivity was on average about 200 µS cm^{-1} higher for GLOBE versus NASQAN sites in the two distributions (Figure 11). There were striking differences in pH, with GLOBE sites being on average about 0.5 pH units below NASQAN sites (Figure 12). In addition, GLOBE pH values span a wider distribution, i.e., the GLOBE site population exhibits more extreme high and low average values than the NASQAN site population.

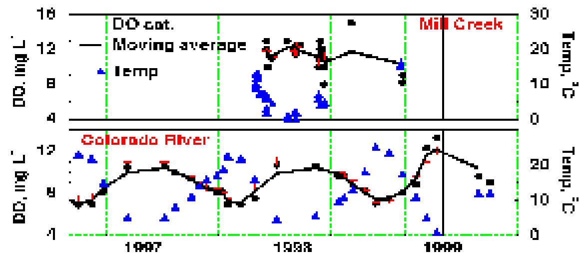
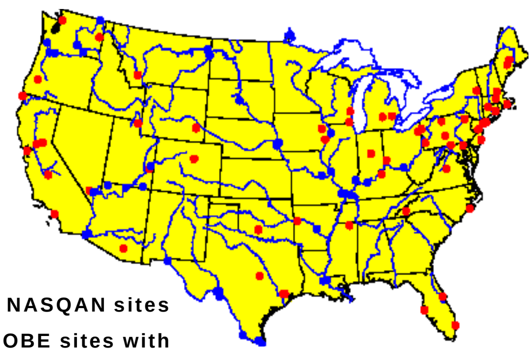


Figure 6. Comparison of trends in Mill Creek and Colorado River temperature and dissolved oxygen.



• 38 NASQAN sites

• GLOBE sites with >500 hydrology measurements

Figure 7: Location of NASQAN sites and U.S. GLOBE sites with more than 500 hydrology measurements as of June 1999.

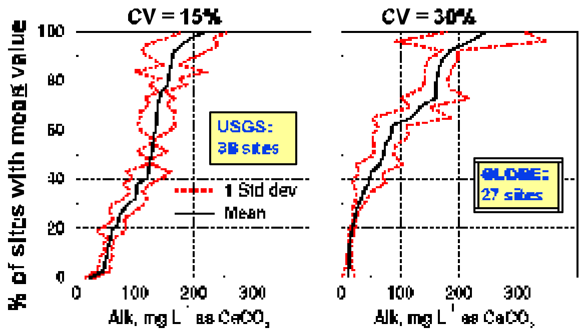


Figure 8: Comparison of GLOBE and NASQAN alkalinity data from sites on Figure 7.

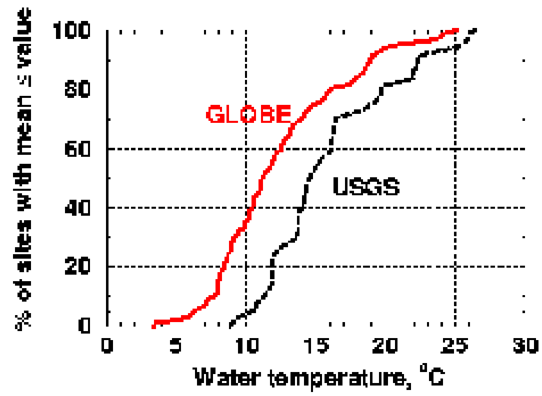


Figure 9: Comparison of GLOBE and USGS NASQAN temperature data from sites on Figure 7.

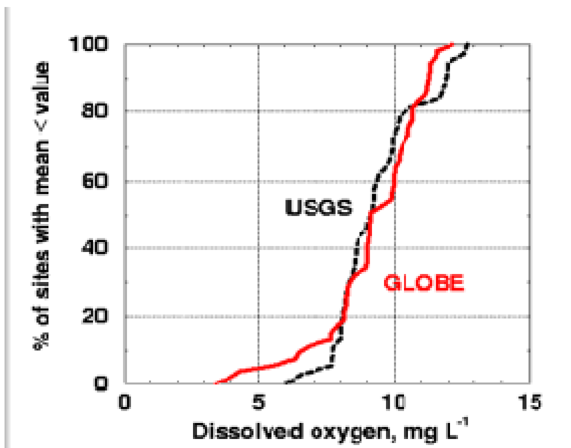


Figure 10: Comparison of GLOBE and NASQAN dissolved oxygen data from sites on Figure 7.

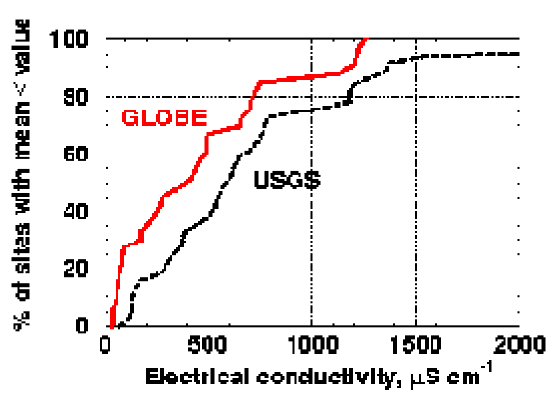


Figure 11: Comparison of GLOBE and NASQAN electrival conductivity data from sites on Figure 7.

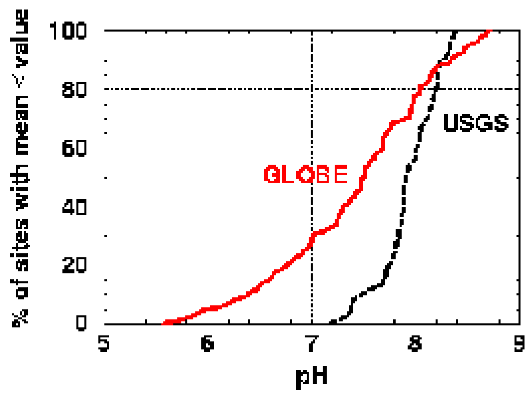


Figure 12: Comparison of GLOBE and NASQUAN pH data from sites on Figure 7.

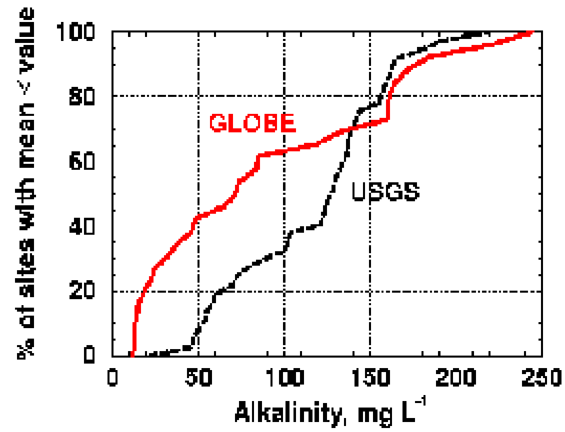


Figure 13: Comparison of GLOBE and NASQUAN alkalinity data from sites on Figure 7.

Discussion

The comparison of the Mill Creek and Colorado River data gives a consistent picture for an upstream, headwater stream being colder and more dilute than the larger. Colorado River, but with about the same pH and alkalinity. Out of all the 38 NASQAN sites, this was the only location that had a nearby tributary being sampled by a GLOBE school for this suite of measurements.

Similarly, the more broadly distributed GLOBE sites were colder, more dilute, more acidic, and less well buffered than the larger rivers that are monitored under the NASQAN program. Note, however, that a large fraction of the NASQAN sites are on rivers where there were few or no GLOBE schools that met the 500-measurement criterion used for this analysis (e.g.. Ohio, Mississippi, Missouri, Rio Grande, and the lower Colorado and Columbia Rivers). There are large concentrations of GLOBE schools in the Northeast, Upper Midwest, and California– areas with few or no NASQAN sites. The NASQAN data set was selected specifically because it represents large rivers; a future analysis should retrieve data from other, less-accessible databases to extend the comparison.

Nonetheless, some important differences do stand out in Figures 9-13. Though dissolved oxygen levels are similar for both distributions, GLOBE temperatures are lower. That means that the dissolved oxygen saturation level is lower for the GLOBE sites than for NASQAN sites. Lower saturation implies that either GLOBE water bodies are slightly under saturated with respect to atmospheric oxygen; GLOBE sites have a higher average elevation; or both. The broader pH distribution for GLOBE water bodies, as compared to NASQAN rivers, suggests that there are greater seasonal fluctuations at GLOBE sites. The 50 mg L^{-1} lower alkalinity for GLOBE sites indicates a greater sensitivity to acidic deposition. In fact, the GLOBE mean alkalinity of about 75 mg L^{-1} indicates that the population of GLOBE water bodies is fairly sensitive to acid inputs. Over 45% of the sites have a mean alkalinity lower than 50 mg L^{-1}, and over 65% have an alkalinity under 100 mg L^{-1}. Small lakes and streams with alkalinity under 100 mg L^{-1} are considered sensitive to acid inputs, and those under 50 mg L^{-1} are considered most sensitive.

The higher coefficient of variation for GLOBE versus NASQAN alkalinity data probably reflects the inherently lower accuracy and precision of GLOBE measurements. GLOBE students measure alkalinity using an endpoint indicator, while the USGS performs potentiometric titrations. Some of the variation may also reflect the greater seasonal variability of GLOBE water bodies versus the large rivers monitored under NASQAN. The recommended frequency for GLOBE water quality sampling is weekly throughout the entire year. However, some schools do measurements monthly. More frequent sampling is needed to achieve accurate results, given the lower precision of GLOBE measurement protocols.

Conclusions

The water quality at GLOBE versus USGS NASQAN sites is different, due in large part to sampling of smaller versus larger water bodies, respectively. Thus, trends in the water quality of GLOBE sites are not well represented by trends in NASQAN data. However, GLOBE measurements can be an important resource for tracking seasonal, interannual, and longer-term trends in the many small water bodies across the U.S. In order to detect differences, changes, and trends more effectively, GLOBE schools should aim to take more frequent samples and develop longer records. Location of more GLOBE hydrology sites on tributaries that are near NASQAN sites is desirable to provide a more definitive, and regionally disaggregated, analysis. Further analysis should also screen GLOBE data for water body and watershed characteristics, to enable using geographic, geologic, and climatic factors to help understand differences in the two populations of sites.

Acknowledgments

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PROGRAM ROUNDTABLE A

Citizen Volunteer Monitoring of Forest Resources in the New York City Watershed

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Introduction

The New York City water supply system is one of the largest storage and water supply systems in the world, supplying high quality, unfiltered drinking water to nearly nine million metropolitan consumers, or approximately half of New York State's population. More than 75 percent of the nearly 2,000 square mile watershed is forested, with the majority of these lands in private ownership. The Watershed's working forests contribute to a viable rural economy, while simultaneously acting as a natural filter for water quality. The potential threat of contamination from pathogens, nutrients, and sediments is a constant concern. Maintaining water quality is highly dependent upon proactive approaches to forest management (Germain et al 2000). In an effort to protect water quality in the New York City (NYC) Watershed, the Watershed Forestry Program (WFP) was created in 1997 to administer forestry outreach and education to loggers, foresters, landowners, and other potential stewards. Since its establishment, outreach and education have primarily focused on the practice and use of forestry best management practices. In a 1999 audit of the program, both the USDA Forest Service and the New York City environmental community recommended more direct citizen participation in monitoring the change in forest conditions over time. This investigation to assess the potential for a citizen volunteer monitoring program followed from this recommendation.

Conceptual Framework

To assess the potential for a citizen volunteer monitoring program in the NYC Watershed, a framework consisting of the following four questions was developed:

1. What specific forest resources can citizen volunteers effectively and credibly monitor?
2. Who are the potential participants?
3. Where can participants collect their data?
4. Who can oversee data management, including feedback to the participants and other interested parties?

These four questions, focusing on the "what," "who," "where," and "how" were subsequently explored and researched. Information gathered along with conclusions and recommendations for future development of a program are presented in this paper.

Methods

Data collection to assess the potential for citizen monitoring in the Watershed began in early June of 1999 and continued through late November. A variety of methods were employed to gather information to help determine the "what," "who," "where," and "how" questions developed as the framework. Individual and group interviews were conducted. Those interviewed included NYC Watershed landowners, Watershed agency personnel, environmental education center staff, scientists conducting research in the Watershed, scientists experienced in working with citizen volunteers, and project coordinators of existing citizen monitoring programs. Information about volunteer monitoring was presented at a number of different meetings of organizations in the Watershed. Feedback and suggestions were solicited from the audience after each of the presentations. Meetings to discuss the potential for and development of the program were held with interested parties, including USDA Forest Service personnel and representatives from the Watershed Forestry Program.

To gain further insight and direction into development of a NYC Watershed volunteer program, local private forest landowners were surveyed. The purpose of the survey was to determine landowner interest in monitoring in general and in participating in a monitoring pilot study, to find out what resources landowners were interested in monitoring, and to generate feedback on further development for the program. A total of 364 questionnaires were sent in a single mailing to private forest landowners, along with a letter describing volunteer monitoring and the potential development of a program in the NYC Watershed. The target population consisted of landowners belonging to one of three different landowner organizations in the Watershed. Sixty-nine questionnaires were returned representing a response rate of 19%.

To help develop a preliminary model for a volunteer monitoring program in the Watershed, two pilot studies were also conducted. Each of the pilot studies targeted a specific audience in the Watershed and used one or more of the forest resources from the developed list of potential resources. Solicited volunteers participated in a training session and subsequently collected data. More specific information on the methods for each of these pilots is outlined later in this paper.

Results

The interviews, presentations, and meetings provided data to address the four areas of the conceptual framework developed to assess the potential for a volunteer monitoring program in the NYC Watershed. The landowner survey provided further insight into how a Watershed program might proceed in terms of targeting potential participants and resources. Two pilot studies generated additional data for how a volunteer monitoring program could be administered in the Watershed. The information gathered is reported below.

What can citizen volunteers monitor?

There are a variety of forest resources that volunteers could monitor. A list along with a brief description of each possible resource follows.

- Forest inventory: tree and vegetation surveys. Tree and vegetation surveys would involve volunteers in measuring actual long-term changes of the Watershed forests. There are several existing programs that could be easily adapted for use in the Watershed. For instance, Illinois Forest Watch engages volunteers in measuring various aspects of tree species, surveying shrub and ground cover layers, and looking for signs of tree damage due to insects and disease (Illinois Natural History Survey 1998). Other potential models include Boreal Forest Watch (Spencer et al 1998) and the North Carolina Vegetation Survey (Peet 1999).

- White-tailed deer. White-tailed deer, well established in the Watershed, are a potential threat to regeneration of its forests. There are many aspects of the deer population and its effects on forest health that volunteers could monitor in the Watershed. These include monitoring deer populations directly by sight, counting pellet groups, conducting browse surveys, and building exclosures to monitor differences between vegetation inside and outside of the exclosure. The Pennsylvania Cooperative Extension has developed a program in Pennsylvania in which volunteers, primarily hunters, count pellet groups and conduct browse surveys (Pearson 1999). A similar program could be adapted for use in the Watershed.

- Ozone bioindicator plants. As part of its Forest Health Monitoring Program (FHM), the USDA Forest Service has developed specific protocols to measure ozone injury on sensitive plant species. Because the sensitive plant species are relatively few in number and easy to identify, and the injury is easy to detect, this aspect of FHM could offer opportunities for volunteers in the Watershed. A 1993 pilot project used volunteers to survey forest plant injury caused by exposure to ozone in mountains in western North Carolina. Volunteers followed protocols adopted from FHM to collect data over the course of one summer. Coordinators deemed the project a great success in terms of data collection and volunteer satisfaction (Morton 1999).

- Insect damage. A number of insects threaten the health of the forest. Several of them, namely the Hemlock Woolly Adelgid, gypsy moth, and tent caterpillar, are already present in the Watershed. The Asian Longhorned Beetle, recently discovered in New York City, has potential to spread to regions outside of the city. Concern, particularly over the Asian Longhorned Beetle and the Hemlock Woolly Adelgid, is high. Given the customarily straight-forward protocol for detection, insect damage surveillance can lend itself to an effective volunteer monitoring program.

- Invasive plant species. Invasive plants are prevalent throughout the Watershed. For example, the distribution of the Japanese Barberry is extensive in particular areas of the Watershed. Other species, such as Purple Loosestrife, can be found throughout the Watershed. These species threaten the growth and distribution of native species, thereby affecting overall forest health. Volunteers could be trained to survey specific areas, and report the distribution and abundance of these or other invasives.

- Salamander populations. Salamanders, such as the Red-backed salamander, are important indicator species for forest health. A protocol for measuring their numbers involves placing bricks or boards in treatment sites, and subsequently checking for salamanders under them. Because the protocol for their inventory is simple, a large audience of different ages can be recruited. The North American Amphibian Monitoring Program (NAAMP) is actively recruiting and working with volunteers to collect data on amphibians, including frogs and salamanders. NAAMP's Terrestrial Salamander Monitoring Program has specific volunteer protocols to help monitor salamander populations. Scientists working in the Watershed are studying salamanders and may be interested in incorporating volunteer data in their work (Gibbs 1999).

- Bird populations. Monitoring bird populations by volunteers in the Watershed could help reflect changes in the forest composition over time. In addition to the Christmas Bird Count, a number of new opportunities have arisen in which volunteers can help monitor birds. For example, Cornell University's Laboratory of Ornithology has also developed a number of "citizen science" programs that use volunteers to monitor a number of bird species, including hawks, thrushes, and the Cerulean Warbler.

- Water quality. Collecting information on water quality would shift the focus away from the monitoring of forest resources. However, due to an already well-established existence of both water monitoring programs and standardized protocols, as well as overall importance in the Watershed, water should be considered as a potential resource for volunteers to monitor. Volunteers could measure water quality in a variety of ways, including chemical monitoring, biological monitoring of aquatic invertebrates, and monitoring physical parameters, such as stream flow and depth. Protocols for volunteers are readily available and can be easily adapted for use by volunteers in the Watershed. Volunteer water quality monitoring is also already taking place to a limited extent in the Watershed at environmental education centers and area schools.

Clearly there are many forest resources that citizen volunteers can monitor. The results from the landowner survey provide some direction for which resources the program in the Watershed might target. On the questionnaire, respondents were given a list of potential resources and asked which one(s) they were most interested in monitoring. Twenty-two of the 69 respondents were interested in conducting tree and vegetation surveys. Eighteen were interested in monitoring deer. The only other resources that landowners expressed particular interest in were monitoring surface water quality (10 responses) and invasive species (9 responses) (Figure 1). Several new possibilities for monitoring were also mentioned. This included acid rain indicators, ferns, and mass production.

Who are the potential participants?

There is a large audience in the NYC Watershed that could be enlisted to participate in volunteer monitoring. Possibilities include primary and/or secondary school children, private forest landowners, visitors to area environmental education centers, participants in Cooperative Extension activities and programs including 4-H campers, and members of environmental organizations that are active in the Watershed.

In choosing a particular group to target for the program, there are a number of factors to consider. First, if data quality is a high priority, special consideration must be made for groups that are most likely to collect data that are accurate and reliable. Second, the resource(s) that will be monitored must be taken into consideration. If the protocols for monitoring are sophisticated, volunteers will need to make the time and commitment for training. Third, there must be ample time for volunteers to collect and report data. Finally, a successful program will rely on a high level of motivation and commitment for the volunteers.

Survey results suggest that private forest landowners could be a successful target audience for a program in the Watershed. To determine overall interest, one of the questions on the survey asked landowners to express their interest in participating in a pilot study to monitor the Hemlock Woolly Adelgid as well as in participating in monitoring activities in general. The results indicated that landowners are interested in monitoring. Of the 69 respondents, 45 indicated that they were interested in attending a workshop that would train participants to monitor the Woolly Adelgid. Twenty-two were not interested in the workshop for various reasons (did not have hemlocks on property, training was too far away, or had other commitments), but were interested in participating in a monitoring program. Only two of the respondents did not wish to participate in any monitoring activity (Figure 2).

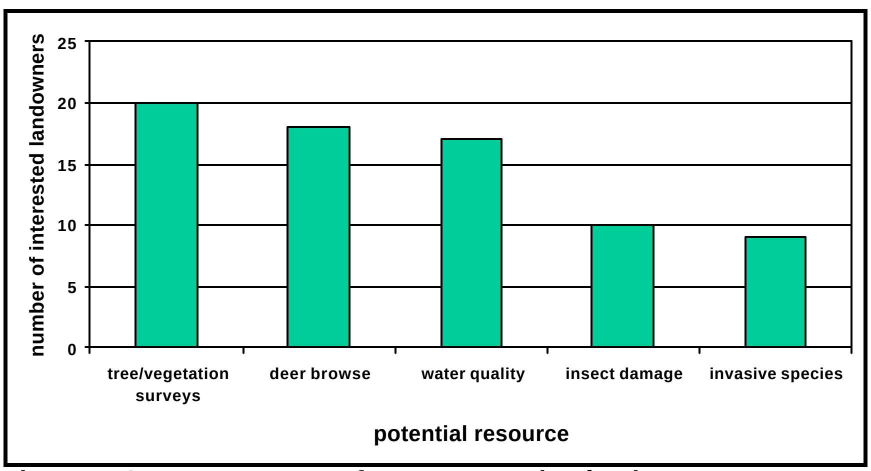

Figure 1: Survey responses for resources that landowners are interested in monitoring (n = 69).

Where can participants collect their data?

There are a variety of places within the NYC Watershed where participants can collect data. School groups and environmental education groups are most likely limited to collecting on their own local grounds. Perhaps most convenient for private landowners and other adult volunteers is to collect data on their own woodlots or properties. However, assuming adult participants are able to travel and have flexible schedules, they can also collect data outside their properties in other areas in the Watershed. For example, data could be collected along roadsides where sites are convenient and easily mapped. One final possibility for data collection is within demonstration forests of the Watershed Model Forest Program. Designed primarily for outreach and educational purposes, these sites highlight a wide variety of forestry and water quality best management practices. Volunteers could monitor how these practices affect forest composition and health over time.

Who can oversee data management, including feedback to the participants and other interested parties?

Data management including the input and analysis of data, as well as providing feedback to volunteer participants, plays a critical role in the success of any volunteer monitoring program. Although this decision is somewhat dependent on the resources that are monitored, there are a number of organizations in the NYC Watershed that can serve this role. This includes scientists from participating universities, the New York State Department of Environmental Conservation, the New York City Department of Environmental Protection, and the USDA Forest Service. Another potential group that is unique to the Watershed is the Olive Natural Heritage Society (ONHS). This group, made up primarily of citizens and landowners, is dedicated to inventorying plants and animals in the Catskills. Members of the group are currently working on a variety of scientific research projects, and have expressed a strong interest in overseeing data management for the volunteer monitoring program.

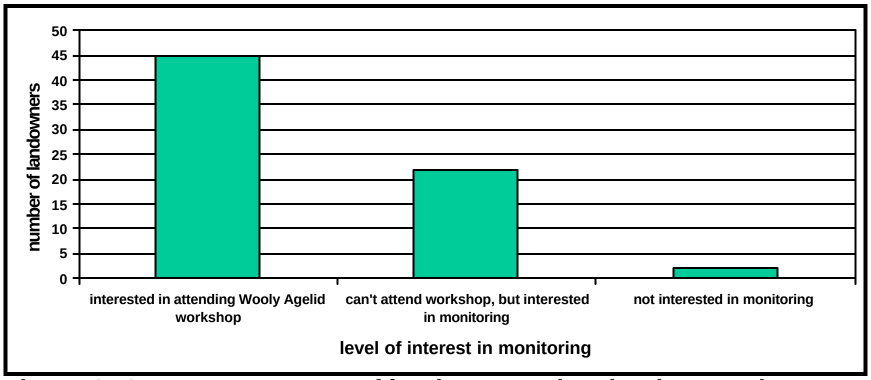

Figure 2: Survey responses of landowners showing interest in participating in monitoring (n = 69).

Results of pilot studies

In collecting information on the "what," "who," "where," and "how" of volunteer monitoring, it became clear that there were a number of decisions that needed to be made in designing a program for the NYC Watershed. To help prioritize the choices and gain some perspective on what was realistic for and appropriate to the Watershed, two separate pilot studies were conducted. Each pilot used one of the audiences generated from the "who" list and tested one or more of the resources from the "what" list. Methods, results, and conclusions for each of these are reported below.

Wildlife monitoring at 4-H Camp Shankitunk

During the summer of 1999, a pilot study was conducted with campers participating in a 4-H camp program, located in the northeastern area of the watershed. Two existing "citizen science" programs were tested. One program was Cornell's "Birds in Forested Landscape" program, in which volunteers monitor woodland thrushes, and the other was the NAAMP Terrestrial Salamander Monitoring Program, involving the placement and subsequent checking of coverboards for salamander activity. The thrush monitoring was conducted close to camp, as the protocol was time-consuming and class time was short. The salamander activity was conducted across the street from the camp in the Lennox Memorial Model Forest, one of the four model forests of the Watershed Forestry Program. Campers ranged in age from six to twelve years old, and typically stayed for one week of camp. Counselors conducted each of these activities once a week with the campers. At the end of the summer, the plan was to send the data in for processing to the respective monitoring programs.

A preliminary informal assessment of the pilot took place half way through the summer. Campers appeared to be gaining better awareness for birds and salamanders, but the actual data collection was not satisfactory. The campers were young and lacked the skills and interest for proper data collection. Counselors were also inexperienced and preoccupied with behavior management.

At the end of the summer, an informal survey was conducted with the counselors that had led the monitoring sessions, and the last group of campers that had participated in them. The results of the counselor survey indicated that of the two activities, the salamander activity was more popular. Counselors enjoyed putting the boards down with the campers, and subsequently exploring for salamanders. However, many counselors noted the challenge of keeping the campers interested. Counselors enjoyed learning about the thrushes, but felt the protocol of calling in the birds was long and tedious. They also expressed disappointment over never seeing any birds. The campers' responses indicated that they learned some facts about both salamanders and birds. They enjoyed seeing the salamanders and learning the birds' calls. Data forms for the "Birds in Forested Landscape" program were collected at the end of the pilot. In examining the results, many of the forms were filled out incorrectly or were incomplete. Consequently, they were not sent to the Lab of Ornithology for processing.

In conclusion, the pilot study was worthwhile in that it generated some interesting and valuable feedback to help further define a program for the Watershed. From an educational standpoint, both the counselors and the campers learned about birds and salamanders, important indicator species, and gained a better understanding of the importance in monitoring their populations. They also gained experience in the procedures of science. However, from a scientific standpoint, the data quality was problematic. The protocols, particularly for the thrush monitoring, were challenging for the young campers to follow. More rigorous training and an older, more captive audience would be more appropriate if accurate, reliable data are important.

Insect pest monitoring – Hemlock Woolly Adeligid workshop
The second pilot study took place in the form of a workshop offered in early November. The workshop provided information and training for detection of the forest pest insect, the Hemlock Woolly Adelgid. This insect attacks and eventually kills Eastern Hemlock, an important riparian tree species in the Watershed.

Landowners were invited to take part in a training workshop led by a representative from the New York State Department of Environmental Conservation. Approximately twenty people came to the training. Participants learned about the life history of the adelgid, how to detect its presence, and how to fill out data forms. They were then instructed to go back to their own properties, collect data on the presence and abundance of adelgids, and send the information back in to the Olive Natural Heritage Society, who offered to serve as a center for data management. The ONHS is now awaiting reports of the volunteers' findings.

The Woolly Adelgid workshop also provided some important data for initial design of a program. Participants were interested and enthusiastic about the project, and appeared willing to make the time and commitment required to collect data on their properties. Towards the conclusion of the workshop, time was allotted for discussion of a monitoring program in the Watershed. Suggestions made included ensuring timely feedback to participants once data were collected and processed and the importance of recruiting additional volunteers.

Recommendations
Based on the results of the work conducted, including personal communication, survey responses, and results from the pilot studies, it is clear that there is a strong interest in volunteer monitoring in the Watershed. We learned that landowners are concerned about the health of the forest and want to get directly involved in monitoring forests over the long-term. We also discovered that scientists conducting studies in the Watershed, as well as executives of the various landowner organizations, see a role for citizen volunteers in the Watershed. Based on this positive response, we provide the following recommendations for developing a program in the Watershed. We also encourage interested organizations outside of the Watershed to use the information gathered to help develop their own programs.

What specific forest resources should citizen volunteers monitor?
<u>Recommendation # 1:</u> To determine what forest resources volunteers will monitor, first decide upon and refine the goals and objectives of a potential program. Citizen volunteer monitoring programs typically strive to meet one or more of the following three goals:

- To educate and inform citizens about a particular resource and its importance in relation to improving or maintaining ecosystem health.
- To provide an opportunity for citizens to become actively involved in the stewardship of local ecosystems.
- To collect data that contributes to science and our understanding of the environment.

Questions that need to be addressed for a program in the Watershed include:

- Given the ultimate goal of maintaining water quality, which forest resources are most appropriate for citizen volunteers to monitor?
- What are the "scientific gaps" that volunteers could help fill?
- What is the purpose of the data?
  - To generate better landowner understanding of the Watershed?
  - To contribute to scientific understanding of the Watershed?
  - To advocate for a change in management or policy?
- What do we expect volunteers to gain in participating in the program?
  - A sense of "making a difference?"
  - A greater awareness of the Watershed?
  - To become better stewards?

<u>Recommendation #2</u>: In deciding what to monitor, consider the results of the landowner survey. The survey indicated that landowners have a strong interest in conducting tree and vegetation surveys, as well as monitoring deer. To help maximize participation, these resources should be given priority.

Who should participate?
<u>Recommendation #3:</u> Focus on landowners as the major participants. Because so much of the land in the Watershed is privately owned, information from this group is important in terms of keeping a "pulse" on forest health. Landowners are eager to get involved, and are already organized in the Watershed. Many either live on their land or visit frequently, and are therefore able to collect data consistently over the long-term. Given the proper training, data collected by landowners will most likely be of good quality.

Where can participants collect their data?
Recommendation #4: Survey landowners as potential participants to determine the most feasible area(s) to focus data collection. Include on the survey a variety of choices, including landowner properties, roadsides and state forest land.

Who can oversee data management?
Recommendation #5: Keep the local Natural Heritage Society (ONHS) an integral part of the program. There are a number of roles that the organization can play, including facilitating the coordination of volunteers, running training workshops, providing experts to assist in data collection, and managing data.

Administrative recommendations
To effectively administer and establish the program for the long term, we provide the following additional recommendations.

Recommendation #6: Develop and maintain a web site for data input and on-going communication about the program.

Recommendation #7: Explore partnerships and identify potential organizations interested in collaboration, both for funding purposes and to provide a strong foundation for the program.

Conclusion: Next Steps
Citizen volunteer monitoring has significant potential in the NYC Watershed. However, resources for developing volunteer programs for monitoring forests are limited. In order to facilitate the development of a program in the Watershed and help ensure its long-term success, we suggest the next step be to examine existing successful citizen volunteer monitoring programs nationwide. Areas to focus on include:

- Determine how goals and objectives were set. Specifically, determine what the criteria were for choosing a particular forest resource or resources to monitor, how the audience for participation was selected, and how decisions were made for where participants would collect data.

- Ascertain the success in achieving their goals and objectives. For example, if the primary goal was to collect volunteer data to add to scientific knowledge of the forest, are volunteer data reliable and valid? Or if the goal was for participants to become better stewards, was there a significant change in the volunteers' attitudes and behavior after participating in monitoring?

- Determine what characteristics programs with a well-established existence have in common that contribute to their long-term success. Specifically, how do these programs maintain interest and participation?

With this additional knowledge, we believe that a sound workable infrastructure for a volunteer monitoring program in the NYC Watershed can be developed successfully for the long term.

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PROGRAM ROUNDTABLE A

The Bear River Watershed Education Project

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Volunteer stream monitoring in Utah promotes a better understanding of how human activities and natural events in a watershed can affect water quality. A stream monitoring curriculum has been developed for grades 5-12. This monitoring program is also being used by volunteer groups to track water quality trends and to evaluate changes resulting from improved management practices. Monitoring programs within Utah rely heavily on many partners, including local, state and federal agencies, Utah State University, private organizations and schools throughout the state.

Most recently, stream monitoring by students is being implemented on a watershed scale in a pilot project in the Bear River drainage (in northern Utah, southern Idaho and western Wyoming). Teachers and students from 11 school districts throughout the basin have adopted a river reach near their school and are monitoring water quality and riparian habitat. The program includes training for teachers and opportunities for students to work with natural resource specialists. The project also encourages investigations of historical and cultural aspects of the river. All data and information are shared on the Internet. Each school is encouraged to develop their own web page which describes their individual program. These sites are all linked to a common site which includes a searchable database and information and interpretation about water quality throughout the entire watershed. Our hope is that this project will help students gain a better understanding of watershed processes, but also will help develop citizens who are active and informed stewards of their watersheds.

STUDENT VOLUNTEERS ON THE WEB

SESSION INFORMATION:

Moderator:

Pete Schade, Montana Watercourse

Presenters:

Steve Amos, Austin Science Academy, 4Empowerment
Cyberways and Waterways: High School Students as Stakeholders and Monitoring Online
(abstract only)

Pete Schade, Montana Watercourse
Creating Your Own Web-Based Interactive Stream Site
(abstract only)

Christos Michalopoulos, GLOBE
Students as Volunteer Monitors: Lessons Learned from the GLOBE Program
(abstract only)

STUDENT VOLUNTEERS ON THE WEB

Cyberways and Waterways: High School Students as Stakeholders and Monitoring Online

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Cyberways & Waterways™™ integrates technology and education by means of an environmentally based curriculum centered on Texas streams, rivers, coastlines and the Gulf of Mexico. Through the creation of a unique public-private sector consortium, funded by a grant from the Texas Education Agency, Cyberways & Waterways brings together the best of the best in education, technology, marine and aquatic science, and the private sector to deliver an innovative education program. This novel online and field study learning program offers students and teachers an unprecedented opportunity to study and electronically visualize the entire Texas watershed from school grounds, streams and rivers to the Flower Gardens coral reef 110 miles off the Texas shore.

Students become technically literate as they develop interdisciplinary real-world skills such as data analysis, graphical presentation, interpretation, critical thinking, and information synthesis using the environment as a contextual framework for learning. The Cyberways & Waterways curriculum, website and resource material are fully bilingual (Spanish and English) to ensure that all students, parents and teachers derive maximum benefit from the program.

The pilot program involves thirteen Texas schools. Cyberways & Waterways directly involves over 14,275 students and indirectly involves 152,433 students in participating school districts. An average of 59% of these students are economically disadvantaged. The ethnic diversity of the target student population is 58% Hispanic, 30% Anglo, and 12% African American. The program will indirectly include more than a million people through consortium member organizations, as well as the nearly limitless population of the World Wide Web.

STUDENT VOLUNTEERS ON THE WEB

Creating Your Own Web-Based Interactive Stream Site

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In August of 1999, the **Montana Volunteer Water Monitoring Project** developed a web-based interactive stream site for 40 teachers and students, participants in Montana State University — Bozeman's STAR (**S**tudents and **T**eachers **a**s **R**esearchers) Project. For three days, participants learned about water quality and conducted water quality field tests on Bridger Creek, a tributary to the Gallatin River. During field sampling, digital photos and video were taken to document the site and the procedures used to collect data. These images were then used to create the STAR Stream Site using Microsoft FrontPage and Kodak's digital imaging technology software. The result was a 360° movable panorama of Bridger Creek, complete with embedded hotlinks to additional information, video and images. By clicking on selected "hot-spots" within the Bridger Creek panorama, users access pages that provide tutorial information on bankfull cross-sections and flow determinations, macroinvertebrate sampling, testing of water chemistry, and other aspects of stream assessment.

The site was presented to STAR participants. Teachers and students were shown how the product was developed, and discussion ensued focusing on how creation of similar sites could be accomplished as a class project. Many schools either already possess the required equipment, or can purchase it inexpensively using school funds or small grants. Such a class project has the advantage of providing self-directed hands-on learning of not only stream ecology and water science, but also technology and web page design. Teachers left excited with the prospect of creating their own classroom learning tutorials and presentations using these new tools.

Equipment needed:

- Pentium Computer (Windows)
- Digital camera (or a regular camera *and* a scanner)
- Tripod
- Software
  - Internet authoring software (Microsoft FrontPage, FrontPage Express, other...)
  - Imaging software (Kodak LivePicture, Reality Studio, other...)

STUDENT VOLUNTEERS ON THE WEB

Students as Volunteer Monitors: Lessons Learned from the GLOBE Program

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Global Learning and Observation to Benefit the Environment (GLOBE) is an international partnership among scientists, teachers, and students from around the world. Young volunteers, under the supervision of their teachers, take measurements of the local environment following established scientific protocols and using instruments that meet strict specifications. The measurements span four major investigation areas: Atmosphere, Hydrology (surface water monitoring), Soil, and Land Cover.

Data are reported, archived, and made publicly available through GLOBE's web page (http://www.globe.gov). Data users include GLOBE scientists who utilize them in their research. The data are also presented as interactive visualizations (maps and graphs) by NASA's Goddard Space Flight Center. These visualizations allow teachers, students, and other users to gain a better understanding of the parameters measured and to engage in science investigations. The web page plays an essential role in serving the GLOBE community. It provides on-line support (Teacher's Guide, "Resource Room"), it facilitates communication ("GLOBEMail" feature, web chats), it enhances cooperation ("School to School" page), and it provides forums for sharing science results ("Scientist Corner" page), student project results ("Student Investigations" page), and instructional strategies and lesson plans ("Educators' Forum" page).

Challenges to participation by schools center on finding the time and resources for implementing the program. Integration of measurement activities into the curriculum is essential. GLOBE environmental observations offer a source of easily understood data that can support inquiry-based student research projects and strengthen implementation of various educational standards.

HOW'S THE SERVICE IN THIS PLACE?

SESSION INFORMATION:

This was a 2-part facilitated discussion with no individual papers or presentations

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Many volunteer monitoring programs depend upon other organizations for a variety of services. These "service providers" may assist in a single facet of monitoring such as providing technical, organizational or financial assistance. Others may provide several services or assist in all aspects of monitoring. While a specific definition of what sets a service provider apart from a volunteer monitoring program may be difficult to agree upon, a common thread is that it is an organization that provides services which enable other groups to conduct water quality monitoring.

The focus of this two-part session was to discuss how we were providing services and to identify ways we can improve. During the first session, issues facing service providers were identified. During the second session, small groups discussed those issues at length. The issues discussed were collaborations, delivery methods, credibility and objectivity, and the evaluation process.

Collaborations are an important tool for assisting monitoring programs. Keys for successfully addressing the unique challenges of collaboration include:

- Identify what organizations are already providing similar services in an area – don't reinvent the wheel or get into turf wars.
- Communicate often and well with your collaborators.
- Plan on it requiring work and good planning.
- Need clear expectations and outcomes:
  - Partnership agreements
  - Memoranda of understanding
  - Specific deliverables
  - Correct level of involvement and commitment
  - Working with solid organizations
- Assess how you will manage your assets and resources:
  - Level of commitment
  - Length of involvement
  - Resources available
  - Organizational mandates

- Ensure accountability and have a "backup strategy in place"
  - Be flexible
  - Have alternatives lined up

- To ensure better collaboration, get a funder to support a facilitator

- Know the "Sacred Cows" of the organizations you intend to collaborate with to ensure that no one will be accidentally treading into dangerous areas.

Delivery methods
Service providers need to have a complete "tool kit" of delivery methods to effectively deliver services to diverse audiences. They must learn to appropriately use new and developing technologies. Websites can be useful as screening tools for programs looking for help and as a way to provide general information. More sophisticated sites can contain training materials as well. However, these sites should not be expected to replace completely personal contact and interaction.

Personal contact requires "someone" to do the contacting and the resources necessary to support that someone. A well-developed structure should be in place with information available to help funnel the public to appropriate alternatives, even if that means starting their own monitoring program. The personal contact approach helps to maintain good public relations, which may in fact help to keep adequate funding.

Trainers networks can include "train the trainers" workshops, stand alone manuals and materials, and follow-up evaluation (certification). What follows are some of the problems and issues to consider related to trainer networks:

- How much training is needed? The group decided that, at a minimum, watershed ecology and decision making is needed in addition to field and classroom training in sampling and analysis

- How to provide effective back-up or follow-up support after training is completed? Solutions include:
  - rely on retired people to help fill the human resource gap
  - co-train with new trainers
  - observe trainers while training
  - back-up, or supporting manuals/materials
  - go out with new trainers/trainees several times after training to answer questions and check on proficiency
  - build cohesive teams consisting of experienced and new volunteers
  - train experienced volunteers to act as mentors

- Training adults often requires different techniques than teaching children. What are some resources or ideas to address this?
  - "How to teach to different levels" chk-alawai@JUNO.COM Claudia Hamlin Katnik
  - Watershed ecology sessions at annual/regional conferences
  - Distance learning (tele-courses, web-based courses, video tapes, etc.)
  - Break websites down into categories for ease of use
  - Challenge – maintain direct, personal contact while allowing the appropriate use of technology (i.e. Internet and distance learning)

- How to get teachers to report data back?
  - Provide Self Addressed Stamped Envelopes (SASE)
  - Collect ALL data sheets, copy them, and then send them back
  - Provide continuing education credits (CEUs) only upon return of data
  - Nag and generally be a nuisance
  - Give half of grant funds up front and the other half upon return of data sheets

Maintaining credibility and objectivity when working with a variety of groups can sometimes be difficult, especially if working with strong advocacy groups. Some keys to help service providers protect their credibility are:

- Partner with people who already have good credibility

- Don't partner with groups that have a specific advocacy plan (not provide monitoring training)

- Make arrangements to include all people involved with an issue in the training

- Provide a disclaimer up front (after all, aren't we all advocates?)

- Be very clear about selection criteria for determining who you will provide training to

- Be very clear about criteria for deciding who to service (grants, training, etc.). Provide a written list of those criteria when people ask for it! Questions to consider – what is the range of stakeholder reps? – is it a watershed scale?

- Use training sessions to make groups aware of their own credibility as well as the complexity of the situation i.e. “Everyone is part of the problem!”
- Make sure that groups with an agenda agree to go through more training than just monitoring
- Sign a statement that they are not acting as agents of your organization
- Need very clear understanding up front about what training provides, how far the mission of the service provider goes, and what will be required for future training
- Develop a policy for how groups can use the trainers’ name.

Maintaining credibility will not be as difficult if the parameters service providers are training groups to monitor are not really complex. Additional problems with credibility and maintaining distance may occur if the advocacy groups want help interpreting the data. Specific issues, such as those that follow, need to be addressed IN ADVANCE to deal with these situations:

- Develop clear criteria for trainer network – build in an evaluation process
- Work with groups to develop clear agreement about what can be done
- Develop training that leads them to the right place – multifaceted training is needed to get at more complex issues
- Establish a clear process for how data is used

How to evaluate and assess ourselves and the groups we provide services to is another important area. Specific issues discussed were:

- Need for new, non-foundational ways to count beans
- Different survey purposes exist: needs assessment vs. how well WE are doing
- The necessity of evaluating the needs, success, and effectiveness of our clients
- Making sure the right tools are being used for the various purposes
- Need to evaluate learning – e.g. watershed consciousness-versus skill level
- A role for evaluation needs to be included in the planning process

Evaluating the ability of individuals to train others can be difficult. Ideas:

- Annually observe or co-teach with each and every trainer (so no one feels singled out) – always try something they suggest to put them at ease and to enhance your own teaching ability
- Pre- and post- training quizzes or surveys to determine what was learned
- Surveys or evaluation forms – things to consider - is statistical meaning important? Do funders care? Do you need a professional to develop and assess properly?

Methods for assessing needs of the volunteer (use several methods!!)

- Oral (one to one discussions)
- Workshop evaluations
- Feedback committee made up of volunteers
- Give assignment at workshops to communicate needs
- Listserve discussion groups
- Self-directed sessions at annual conferences
- Provide very general grant monies (see what they are interested in doing)
- Have a technical committee

- Networking meeting – localized or statewide
- Have groups do study design in order to get a grant (from which you can determine the skills, equipment and technical support they will need)

Some resources for assessment and evaluation:

- “How To Conduct Your Own Survey” by Priscilla Salant and Don A. Dillman, 256 pages 1 edition (October 27, 1994) John Wiley & Sons; ISBN: 0471012734
- Assessment rubrics websites:
  - http://www.pasd.com/PSSA/writing/esr/intro.htm
  - http://connect.barry.edu/ect607/Assessment/Assess.htm
  - http://www.music.utah.edu/assessment/rubricsCreat.html
- Cooperative Extension, U Minnesota – Center for Survey Research (Inexpensive if the initial survey is completed)

Before starting the evaluation process some things to consider are:

- You can’t assess how well you did without assessing how the group you trained is doing. For examples, see River Network or Colorado Division of Wildlife forms
- Processes for internal and external evaluations
- Who is the audience for the evaluation? Funders – volunteers?? Different needs, so use different tools (questions)
- How to get info back to funders
- Plug in evaluations at the start, circular versus linear process
- Interactive evaluation and change in response to the evaluation
- Why do we evaluate?? Only because it’s mandated??
- How much do we link our efforts with change? Cause and effect??
- We NEED TO SHARE THE CREDIT – robs ownership otherwise

Some examples of evaluation processes:

- Home*A*Syst surveys participants before a workshop on household practices – then (up to 1 year later) post training survey to see what changes were made.
- Mass Water Watch – at the beginning of the year, MWW holds study design session. Then, at the end of the year they hold data interpretation sessions that include “what to do next year,” and “what are your needs.” They use data interpretation as the hook.